

The endangered Myrtle's silverspot butterfly: present status and initial conservation planning

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Abstract. The endangered Myrtle's silverspot butterfly, *Speyeria zerene myrtleae* (Nymphalidae), was studied during a three-year period at the Point Reyes National Seashore and at the site of a proposed resort. Surveys were conducted across much of this insect's historic range. Three large concentrations of Myrtle's silverspot butterflies were identified: two in Point Reyes National Seashore, and one in the coastal prairie and scrub in the vicinity of the Marin-Sonoma county boundary. Continued habitat loss and habitat degradation are the most likely threats. Conservation planning for this butterfly is ongoing, and must include ecosystem management in conjunction with the preservation of suitable habitat.

INTRODUCTION

On 22 June 1992 the U.S. Fish and Wildlife Service issued a final ruling listing Myrtle's silverspot butterfly (*Speyeria zerene myrtleae* dos Passos and Grey 1945) as an endangered species pursuant to the Endangered Species Act of 1973 (Federal Register 1992). This ruling was deemed justified in order to protect this insect from imminent extinction due to threats resulting from past and proposed habitat loss resulting from residential and commercial development, and from threats due to widespread habitat degradation associated with invasive alien plant species and destructive agricultural practices.

As a consequence of the listing, conservation planning for the Myrtle's silverspot butterfly has become a prime land planning consideration for coastal Marin and Sonoma counties in northern California. While anecdotal data on Myrtle's silverspot butterfly existed at the time of listing, the data were not of sufficient extent or quality to allow comprehensive conservation planning. Specifically, little reliable information existed concerning the number and distribution of Myrtle's silverspot butterfly populations, the approximate number of butterflies in each population, the seasonal phenology, the rates and distances of butterfly dispersal, and the distribution and abundance of larval hostplants and plants that may provide nectar to adults. Without these data conservation activities designed for this butterfly could be oriented at the incorrect spatial and temporal scales, and would not serve to preserve this insect.

While the data shortfall on this subspecies remains profound, this report summarizes recent findings on the biology of Myrtle's silverspot butterfly, and relates these findings to conservation planning for this endangered subspecies.

BACKGROUND ON MYRTLE'S SILVERSPOT BUTTERFLY

Myrtle's silverspot butterfly is a subspecies in the diverse *Speyeria zerene* species complex (dos Passos and Grey 1947, Grey and Moeck 1962, Hammond and McCorkle 1983, McCorkle 1980). Populations of this butterfly species are found scattered across western North America, from the Rocky Mountains west to the coast of central California, and from northwestern Arizona north to southeastern Alaska (Scott 1986). Across this region, *Speyeria zerene* is found in habitats ranging from coastal dune-grassland communities to inland, mid-elevation sagebrush and forest communities. The groups of *Speyeria zerene* populations that have been designated as distinct subspecies are defined primarily on the basis of adult butterfly morphology, geographic distribution, habitat type, and, to a limited extent, inferred phylogenetic affinities (dos Passos and Grey 1945, Grey and Moeck 1962, McCorkle 1980).

Myrtle's silverspot butterfly is thought to be the southernmost entity of a *Speyeria zerene* clade that inhabits the west coast of North America. This group includes the Oregon silverspot butterfly, *Speyeria zerene hippolyta* (protected by the federal Endangered Species Act as a "threatened species"), and Behrens' silverspot butterfly, *Speyeria zerene behrensii* (a candidate for federal protection), as well as Myrtle's silverspot butterfly (Brittnacher *et al.* 1978, dos Passos and Grey 1945, Grey and Moeck 1962, McCorkle 1980). Populations of Myrtle's silverspot butterfly formerly were found in dunes and bluffs from coastal San Mateo County in the south, to the vicinity of Jenner Beach (Sonoma County) in the north (Steiner 1990) (Map 1). Populations of *Speyeria zerene* butterflies containing individuals phenotypically intermediate between Myrtle's silverspot butterfly and Behrens' silverspot butterfly were known to exist north of Jenner Beach and south of Anchor Bay (Mendocino County).

By the late 1970s Myrtle's silverspot butterfly populations south of the Golden Gate were thought to be extinct, and the butterfly was considered to still be thriving only at the Point Reyes National Seashore. In 1990, Myrtle's silverspot butterflies were observed in the coastal grasslands north of Estero de San Antonio, at the site of the proposed Marin Coast Golf Ranch (Arnold 1990). This observation triggered studies at the proposed resort site and throughout the historic range of the butterfly. Starting in 1991, extensive field studies on Myrtle's silverspot butterflies were conducted by researchers from the Center for Conservation Biology at Stanford University. These studies were expanded to include field work at Point Reyes National Seashore in 1992.

CONSERVATION PLANNING FOR MYRTLE'S SILVERSPOT BUTTERFLY

Concurrent with federal protection under the Endangered Species Act, conservation planning for Myrtle's silverspot butterfly was initiated on two different levels. Site-specific information on potential impacts construction would have on the butterfly was required at the 510 hectare Marin Coast Golf Ranch (MCGR). On a more general level, baseline

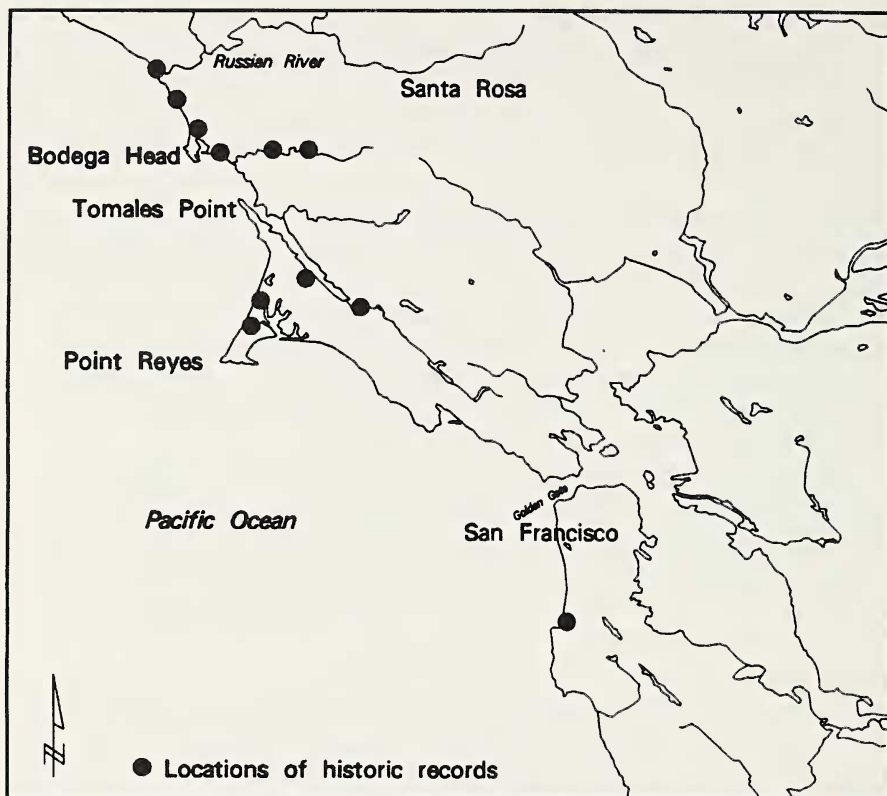


Figure 1. Distribution of historic collection sites of Myrtle's silverspot butterfly (after Steiner 1990, and numerous communications with local lepidopterists). Note that the type locality, San Mateo California (dos Passos and Grey 1945), could refer to either the county of San Mateo, including Pacific coastal areas known historically to support the butterfly, or to the town of San Mateo, located on the bay-side of the San Francisco Peninsula — an area we consider unlikely to have historically supported a Myrtle's silverspot butterfly population. For this report, the source of the type specimens is considered to be coastal San Mateo County, probably in the vicinity of the town of Pacifica. Also note that the zerene butterflies from the vicinity of Jenner are occasionally considered intermediate between *S. z. myrtleae* and *S. z. behrensii*. (Map was created using ARC/INFO and the Digital Chart of the World.)

information on broad patterns of distribution and abundance within the approximately 28,500 hectare Point Reyes National Seashore (PRNS) was needed to determine the status of the insect within the reserve and to determine if a management plan specifically designed to protect the butterfly was warranted. While these two planning efforts were different in breadth and, to some extent, conservation orientation, it was evident at the onset that both projects required field activities to address the shortfall of reliable data.

Information on the site-specific distribution and abundance, including measures of both relative and absolute abundance of adult butterflies, larval hostplants, and plants potentially providing nectar was needed for preliminary planning at the proposed MCGR. Also needed for initial planning at the MCGR site was information on butterfly dispersal and phenology, and on the status of the butterfly in surrounding regions. Off-site surveys were considered necessary in order to put site-specific information into a proper regional context, because on-site conservation planning is strongly dependent on the target organism's local and regional status. For the second phase of conservation planning at the MCGR, precise information was needed on the spatial distribution of the butterfly in areas where development was proposed, for purposes of the design of management activities.

At Point Reyes National Seashore baseline information on distribution and abundance of the butterfly was lacking. Myrtle's silverspot butterfly was known to occur in several locations at the Seashore, but much of the Seashore had not been surveyed. Along with baseline information, the development of a long-term monitoring scheme and management options were initiated.

METHODS

Beginning April 1991 and continuing through September 1993, field activities were conducted on 115 days (including portions of 245 person-days). Most of the work centered on two locations, the Point Reyes National Seashore and the site of the proposed Marin Coast Golf Resort. On twenty days during the peak adult butterfly flight periods (as determined by on-going work at PRNS and the MCGR), surveys for Myrtle's silverspot butterflies were conducted in numerous locations throughout the recent range of the butterfly (survey sites distributed from the vicinity of Jenner Beach to the southern coast of Tomales Bay).

Mark-recapture activities were conducted during two seasons, in 1991 at the MCGR and in 1993 at PRNS. These activities were conducted according to the techniques described in Ehrlich and Davidson (1960). This method has been found to have no lasting impacts on comparatively large and robust butterflies, such as Myrtle's silverspot butterfly (Orive and Baughman 1989, but see Murphy 1988 for caveats). At the time of capture each butterfly was individually marked, sexed, and scored for wing wear (a measure of age). Data were analyzed using a Jolly-Seber population estimation program. The mark-recapture study was designed to be the first step in delineating population boundaries and in estimating the absolute number of Myrtle's silverspot butterflies at each of the two primary study sites. The timing of adult butterfly emergence was estimated on the basis of condition at first capture (individuals scored as wear condition 0.5 were assumed to have eclosed within two days of capture, individuals of condition 1.0 were assumed to have eclosed three to five days prior to capture, etc.).

The MCGR site was divided into 15 subareas, each approximately 35 hectares in extent (Launer and Murphy 1991). These subareas roughly corresponded to topographic features at the site. In 1991, each of these subareas was used as a focal point for the mark-recapture study. In addition to the mark-recapture activities, the amount of time spent in each subarea, and the number of

butterflies handled or observed but not handled (used as an estimate of non-captured butterflies) were recorded in order to calculate a relative measure of butterfly abundance (butterflies per observer-hour). In 1992 and 1993, kilometer-long transects were located in each of the 15 subareas in an effort to quantify relative abundance (Pollard and Yates 1993). Transects were designed to be representative of the topographic and biotic diversity present in each of the subareas. Transects were walked at a consistent pace on five occasions during periods of appropriate weather during both the 1992 and 1993 seasons. Transect walks were designed to be conducted weekly during peak butterfly flight period, but inclement weather eliminated some periods, hence the mean time between sampling periods was approximately ten days in 1992 and four days in 1993. All butterflies observed within five meters and in front of field workers were counted; those butterflies either behind observers or farther than five meters distant were not counted (Launer and Murphy 1992).

At PRNS, the 1993 mark-recapture study was centered at the dune-scrub interface located at North Beach. In this area, comparatively large numbers of butterflies were observed in 1992 visiting the abundant wildflowers (*Grindelia rubicaulis*, *Abronia latifolia*, *Monardella undulata*, and *Erigeron glaucus*) (Sparrow and Launer 1992). To the east of the North Beach site, in scrub and grassland communities, Myrtle's silverspot butterflies were observed on occasion, but were too dispersed to be effectively included in the mark-recapture study.

In 1991, prior to federal protection, voucher specimens from the MCGR were retained on a weekly basis. On average, five specimens were collected each week during the study period, and were taken only after it was apparent that the population at the site consisted of several thousands of individuals. Sampling at this low intensity is thought to be of negligible impact to butterfly populations (Harrison *et al.* 1991).

RESULTS AND DISCUSSION

Distribution

Surveys documented Myrtle's silverspot butterflies in two broad areas at Point Reyes National Seashore and at the proposed Marin Coast Golf Ranch site (Map 2). Surveys also documented Myrtle's silverspot butterflies in locations surrounding the MCGR, including Estero Lane (Sonoma County), Estero Road (Marin County), and the hills between Dillon Beach and Estero de San Antonio (Marin County). No Myrtle's silverspot butterflies were observed at any other survey sites. While the results of these surveys should not be taken as conclusive evidence of absence of the subspecies from areas where they were not observed, it is unlikely that large concentrations of Myrtle's silverspot butterflies, such as those observed at PRNS and at MCGR, exist in publicly accessible areas located between Jenner Beach and the Bodega Bay Golf Course, or in areas located between Dillon Beach and Point Reyes Station. There are, however, inaccessible private landholdings in the coastal region that appear to be capable of supporting Myrtle's silverspot butterflies, and unknown populations of the butterfly inland could also exist.

At PRNS, Myrtle's silverspot butterflies were found at the Tomales Point tule elk range and throughout the bluffs, hills, grasslands, and

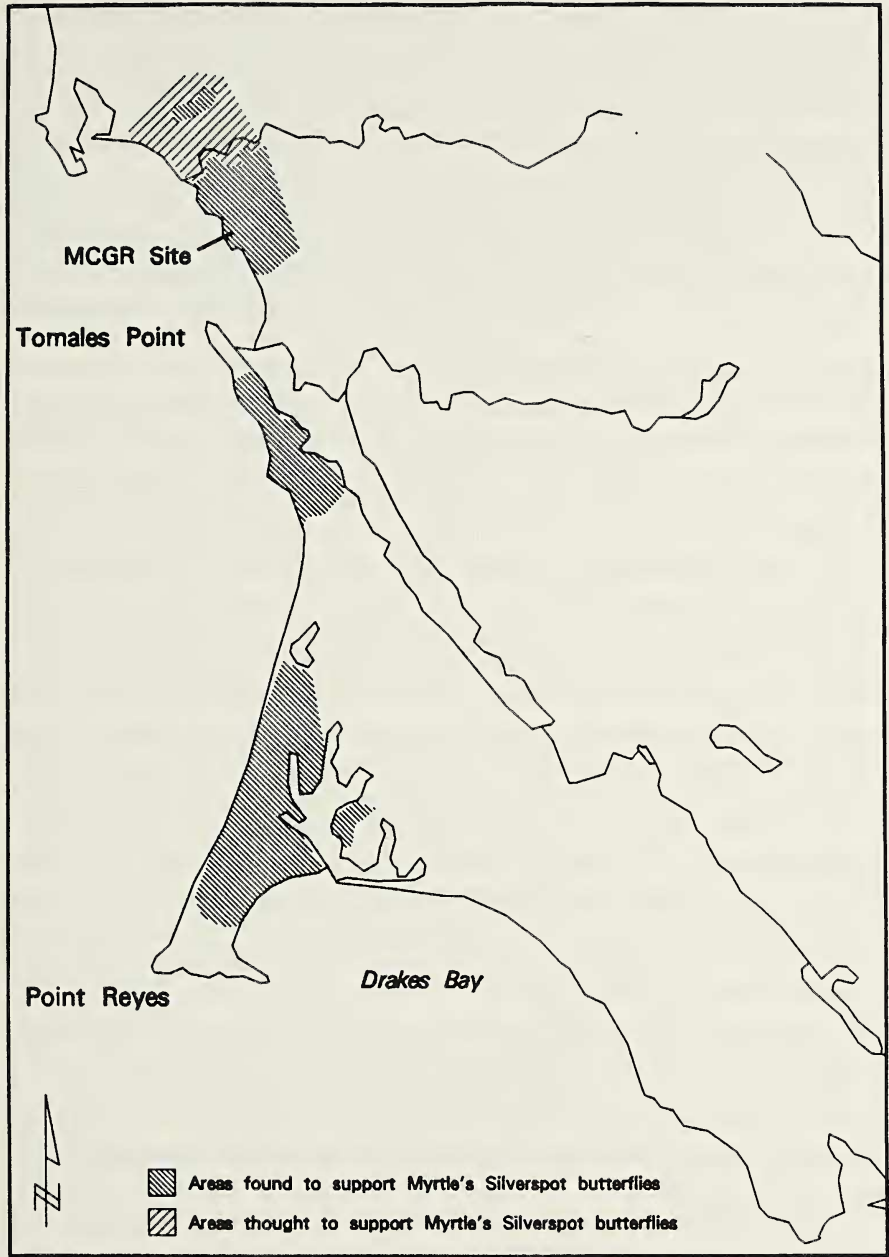


Figure 2. Present distribution of Myrtle's silverspot butterfly. (Map was created using ARC/INFO and the Digital Chart of the World.)

back-dunes west of Drakes Estero and Schooner Bay (Map 2) . Within each of these two areas, butterflies were found in varying abundances — high concentrations were associated with locations protected from the frequent winds, or with areas supporting large numbers of plants that potentially provide nectar.

Myrtle's silverspot butterflies were unevenly distributed across the MCGR site. Most of the butterflies were recorded from two areas — an approximately 2.5 kilometer coastal drainage system forming part of the northern boundary of the site (and including adjacent off-site areas), and along the Estero de San Antonio. This distribution was consistent in 1991 and 1992. In 1993, a slight shift in distribution was observed that included an expansion by the butterflies into a subarea that had been sparsely occupied in previous years. This slight expansion may have been related to an apparent increase in the density of bull thistles in the newly occupied subarea, but such a causal relationship can only be inferred.

Estimated number of Myrtle's silverspot butterflies

At Point Reyes National Seashore (North Beach) in 1993, 76 Myrtle's silverspot butterflies were marked (38 males and 38 females), and 24 recaptures were recorded. The low numbers of recaptures is problematic for several of the algorithms used by Jolly-Seber population estimation programs, and eliminates the possibility of a precise population estimate. However, if changes in daily population levels are assumed to be fairly consistent and calculations are made using a range of Scott's average phi values (in this case, the data indicated a range of average phi values from 0.2 to .06), a fairly reliable estimate can be derived. Using these corrections, between 200 to 600 individual butterflies were estimated to visiting the back-dune areas adjacent to North Beach in 1993.

The estimate of between 200 to 600 individual butterflies should not be taken as an estimate of overall population size in central Point Reyes since we were unable to delineate spatial boundaries of the population, and it is probable that the butterflies visiting the nectar sources at North Beach constitute only a fraction of an extended population. Based on the mark-recapture study and on extensive observations, it is likely that more than 1,000 butterflies but fewer than 5,000 butterflies were present in central Point Reyes in 1993.

At the Marin Coast Golf Ranch site in 1991, 255 Myrtle's silverspot butterflies were marked and then released. Unfortunately, only 19 recaptures were recorded (this low number of recaptures is even more surprising considering that 120 additional observations of unmarked butterflies were recorded out of the context of the mark-recapture study). Again, the comparatively small number recaptures precludes a precise estimate of the total number of butterflies present on the MCGR site in 1991, but it suggests that the effort sampled a large and open population. After considering a number of factors including the length of the adult butterfly flight season, the number of recaptured individuals in relation to the number of marked butterflies, butterfly wear rates, and apparent limitations to butterfly dispersal, a conservative estimate of between 2,500 and 5,000 adult Myrtle's silverspot butterflies are thought to have resided at the proposed resort site in 1991.

Phenology of Myrtle's silverspot butterfly

Onset of the adult butterfly flight season varied between years and between sites. In 1991 adult butterflies were estimated to have begun emerging during the second week of July at the Marin Coast Golf Resort. In contrast, both the 1992 and 1993 adult butterfly flight seasons at the MCGR were projected to have begun in late June. During 1991 to 1993 at Point Reyes National Seashore, the onset of the Myrtle's silverspot butterfly flight season was apparently initiated in mid- to late June. In general, onset of Myrtle's silverspot butterfly flight season was one to two weeks earlier at PRNS than at MCGR. It should be noted that across the Bay area in 1991 many phenological events were exceptionally late — butterfly flight seasons and plant flowering periods were documented as comparatively delayed (for example, the 1991 onset of the Bay checkerspot butterfly flight period at Stanford University's Jasper Ridge was the latest recorded in 33 years of population censusing).

Adult butterflies were present continuously at the two primary study sites for at least two months each year, and in 1991 butterflies were last observed on the MCGR site on 5 October — indicating a three month flight season. During the two to three month flight period, a number of demographic shifts were evident, and large numbers of adult butterflies were observed from the second week of July until mid- to late August. Although individuals of both sexes were found together throughout the flight season, an approximate ten day difference in the peak flight times of the two sexes was apparent; adult male butterflies appeared to reach peak abundance in late July, while adult female butterfly abundance appeared to peak during the first two weeks of August. Note again that 1991 was probably an exceptional year, and peak abundances were not reached until 20 August for males and 1 September for females. The extended flight season exhibited by Myrtle's silverspot butterflies is consistent with other Lepidoptera inhabiting coastal areas (Hammond and McCorkle 1983, Langston 1974). Weather at the primary study sites strongly impacts adult butterfly activity. While butterflies were invariably active during periods of overcast, but calm weather, they ceased to be active during periods of foggy and windy weather. Such inclement weather conditions frequently occurred: indeed, during the three-year study period no adult butterfly activity at all was noted on more than 25% of the days during the adult flight season, and butterfly activity was minimal on many of the remaining days. Days of weather sufficiently mild as to allow for complete days of butterfly activity were uncommon, and most days had only a three or four hour period when the butterflies were active.

Habitat

The habitat of the Myrtle's silverspot butterfly has been considered to include only low elevation dune and grassland areas immediately inland from the coast. This habitat is well within the summer "fog belt," a

physical setting that ensures comparatively buffered environmental conditions. Coastal bluff grasslands and scrub at higher elevations were not considered to serve as primary habitat for the Myrtle's silverspot butterfly. However, work at the Marin Coast Golf Ranch site and at Point Reyes National Seashore determined that grasslands and small valleys located amidst rolling hills may be densely populated by the butterfly. In particular, areas protected from the persistent wind, up to five kilometers from the coast and up to 250 meters in elevation, were found to support substantial numbers of adult butterflies.

Viola adunca, the presumed larval hostplant, is patchily distributed throughout the region, and inhabits a range of biological communities, including grassland, scrub, and dune plant communities. The presence of *Viola adunca*, therefore, is not a reliable predictor of the presence of Myrtle's silverspot butterflies. Determinations of habitat suitability must be based on multiple factors, including, but not limited to, distribution of larval hostplants.

The plant species available that potentially provide nectar differ between the upland and dune habitat areas. In the grassy uplands, especially those subject to grazing by livestock, native plant species potentially providing nectar are generally scarce. Butterflies were frequently observed visiting bull thistle, *Cirsium vulgare*. This alien species is widespread in disturbed areas, along roads and fencelines, and in comparatively moist areas. Another alien plant species, Italian thistle (*Carduus pycnocephalus*), is also abundant in disturbed areas (particularly overgrazed areas), and was visited by butterflies that were active before mid-July. In upland areas, very few visits to native plant species were observed. At PRNS, *Grindelia* (probably *G. rubicaulis*) and *Monardella* (probably *M. villosa*) were occasionally visited, and at the MCGR, *Monardella villosa* was visited. At the dune-scrub interface in central PRNS, *Grindelia rubicaulis*, *Abronia latifolia*, and *Monardella undulata* were visited regularly by Myrtle's silverspot butterflies. In this zone, *Grindelia* and *Abronia* are found in dense patches up to several meters in diameter. Butterflies frequented these large patches. *Erigeron glaucus* was visited to lesser degree. *Cirsium vulgare* was rarely visited by Myrtle's silverspot butterflies in the dune-scrub zone. Flowers of the invasive iceplant (*Mesembryanthemum* species) were never visited by Myrtle's silverspot butterflies.

The availability of nectar is potentially a critical factor for the long-term persistence of Myrtle's silverspot butterfly populations. In a related species, *Speyeria mormonia*, a strong correlation exists between the amount of nectar consumed by female butterflies and the number of eggs they produce (Boggs and Ross 1993). This implies that under field conditions, reduced nectar availability can limit the total number of eggs produced, and can result in a reduction in the number of offspring that survive to become adults in the subsequent year (assuming that there is negligible density dependent mortality of larvae). Widespread overgraz-

ing in the region may have substantially reduced the availability of nectar (particularly native plant species), and could be contributing to a regional decline of the butterfly.

Adult butterfly dispersal and the spatial scale of Myrtle's silverspot butterfly populations

At the Marin Coast Golf Ranch site in 1991, few butterflies were recaptured in subareas different from those of their initial capture. Slightly more than 50% (10 of 19) of recaptured butterflies were taken in the same subarea as initially recorded, and 95% (18 of 19) of all recaptures were made in either the same subarea as initial capture or in an immediately adjacent subarea. Only 5% (1 of 19) of butterflies captured more than once dispersed to a non-adjacent subarea. The mean distance traveled by all recaptured individuals was approximately 75 meters (the mean value for distance moved between recapture events is based on distance between center points of the subareas). Of those butterflies documented to have moved into a different subarea, the mean distance traveled was approximately 350 meters, and the longest recorded movement was approximately 1,500 meters.

When these results from the mark-recapture study are coupled with the extensive observations at the proposed resort site during the three study years, it appears that Myrtle's silverspot butterflies generally stayed within circumscribed topographic units — coastal drainage systems separated by wind-swept ridges and exposed grasslands. Within these protected areas, daily movements of several hundred meters are undoubtedly frequent, and longer movements, up to and likely exceeding the 1,500 meters recorded by the mark-recapture study, are not unusual.

Dispersal between the two "large" drainage systems at the MCGR site was not recorded during the course of this study. However, given the vagility of the butterflies, and the comparatively short distances between drainages, it is probable that dispersal between drainage systems does occur.

At the dune-scrub interface at Point Reyes, high concentrations of nectar-producing plants attract butterflies from unknown and perhaps distant natal areas; observations imply movements on the order of several kilometers. During 1992 and 1993, there were numerous observations of butterflies flying without stopping through the grasslands and scrub east of North Beach, and across the main road. While conclusive proof of movements between distant population centers would be desirable, the practicalities of conducting a mark-recapture study in areas supporting low butterfly densities eliminated this option.

The balanced sex ratio observed at North Beach in 1993 (50:50) may indicate that only a subset of a population was sampled. In general, female butterflies are less likely to be encountered, hence captured, than are male butterflies, and mark-recapture studies nearly always involve the handling of more males than females (Ehrlich *et al.* 1984). The few

instances in which more females than males are captured typically occur when sampling is restricted to the end of the flight season (butterflies, and *Speyeria* in particular, are generally protandrous), or when sampling occurs where scarce resources attract disproportionate numbers of females from surrounding areas. The first possibility is unlikely in this case; the timing of the 1993 study indicates that females may have been undersampled. It is probable that the North Beach study site represents just a portion of the geographic range of an open and highly dispersed Myrtle's silverspot butterfly population residing in central Point Reyes.

While conclusive determination on the geographic extent of Myrtle's silverspot butterfly populations is lacking, these studies indicate that it is probable that at least three demographically independent populations of Myrtle's silverspot butterflies exist: central Point Reyes (including areas in the vicinity of North Beach, South Beach, and Drake's Beach); Tomales Point (within the PRNS tule elk range); and in the vicinity of the MCGR (this population probably extends north to Estero Lane in Sonoma County). It is unclear the degree to which these ostensible populations, particularly those located at MCGR and central PRNS, are subdivided, but it is likely that substantial interchange of individuals occurs between areas of high butterfly density within each of the three areas. Similarly diffuse populations of this approximate geographic scale have been suggested previously for the Oregon silverspot butterfly (Pickering *et al.* 1991, Pickering *et al.* 1992).

CONCLUSIONS AND RECOMMENDATIONS

Species-specific conservation planning is never an easy task, but working with an invertebrate species presents an especially daunting set of challenges — particularly when the available period of investigation is limited (New 1991, Pollard and Yates 1993). Distribution and abundance “snap-shots” of butterfly populations and metapopulations, that is studies based on single or two consecutive field seasons, need to be viewed in the context of dynamic natural fluctuations typical of such systems (Baughman and Murphy 1990). In light of the lack of a historic perspective, the precise status of *Speyeria zerene myrtleae* remains largely unresolved. It is fairly certain that this butterfly has declined in distribution and in abundance; and even with the large number of butterflies inhabiting the nominally protected lands of Point Reyes National Seashore, this butterfly warrants the protection it has been afforded under the Endangered Species Act. However, considering the large extent of generally inaccessible private land in the region, there may be undiscovered populations of Myrtle's silverspot butterflies scattered across coastal Marin and Sonoma Counties. It is doubtful that any populations of Myrtle's silverspot butterfly exist south of the Golden Gate. It is also possible that inland populations of Myrtle's silverspot butterflies exist since the ecologically similar Oregon silverspot butterfly, *Speyeria zerene hippolyta*, is present at Mount Hebo, a site well away from the coast.

At Point Reyes National Seashore, the distribution and abundance of the butterfly indicate it is not in immediate danger of extinction, and that even without conservation actions specifically targeting the butterfly, this subspecies will likely persist within the park for some time to come — an observation that suggests that design and implementation of management activities need not be carried out under the “crisis management” timetable so frequent to conservation efforts. Long-term persistence of Myrtle’s silverspot butterfly, however, is not guaranteed because the cumulative impacts of grazing (from both domestic livestock and tule elk), invasive alien plant species, and possibly the suppression of natural disturbances, are not well understood. The region-wide decline of the butterfly implies that such cumulative impacts have been significant and may eventually threaten the existence of the butterfly even at PRNS.

The ecosystems of coastal California, including PRNS, have been altered significantly by more than one hundred years of human activities and by the invasions of alien plant and animal species. Unfortunately, the impacts of these activities are likely so pervasive that complete cessation of some commercial ventures, specifically grazing, would probably lead to the loss of native species as non-native species slowly eliminate them (Davis and Sherman 1992, Elliott and Wehausen 1974, Hardham and True 1972, Hektner and Foin 1974). With this virtually permanent alteration of the habitats that support Myrtle’s silverspot butterfly comes the necessity of long-term management — simply setting aside land for butterfly reserves with no active management will be insufficient for the conservation of this insect. Perhaps the most important of the management options is the identification of grazing regimes that are beneficial to larval hostplants and plants providing nectar resources, and conservation planning for Myrtle’s silverspot butterfly should include scientifically defensible grazing and habitat restoration experiments. As it is inconceivable that one grazing regime will prove optimal for all components of biotic diversity in the region, and because many effects of grazing may not be apparent for many years, long-term conservation planning at PRNS should incorporate areas subjected to range of grazing pressures — from no livestock to comparatively high densities of livestock.

Unfortunately, managed grazing will not be a complete solution. In the back-dune areas, use of grazing to minimize the impacts of non-native species, particularly iceplant, will not be appropriate. It is unlikely that native plant species dwelling on the physically loose substrates of the dune areas would benefit from livestock, and such disruption could exacerbate the transition from native to non-native plant species. In that these dune communities apparently provide nectar resources critical to the long-term persistence of Myrtle’s silverspot butterflies, programs of iceplant control and dune restoration need to be initiated. With the reality that iceplant will not be eliminated from PRNS in the foreseeable future (if ever), areas still supporting comparatively high densities of

native plant species, such as the back-dunes at North Beach, need to be focal points of such control and restoration efforts.

Another apparent conservation problem faced by Myrtle's silverspot butterfly is the collection of specimens. While it is very doubtful that collection of specimens has ever constituted a threat to any Myrtle's silverspot butterfly population, areas where comparatively high concentrations of female butterflies can be found, such as North Beach at PRNS, should be patrolled during the adult butterfly flight season to discourage poaching.

At the proposed Marin Coast Golf Ranch, studies indicate that Myrtle's silverspot butterflies are more or less absent from a sizable portion of the site, hence development of some areas could have a negligible impact on the butterfly. However, a problem for site-specific conservation efforts designed for the butterfly is that the MCGR site constitutes only a portion of the distribution of a widespread butterfly population. This is a near universal problem with site-specific planning in that most butterfly populations are not encompassed in their entirety by political or human-defined boundaries. As a result, site-specific planning efforts tend to focus on just portions of populations, and adjacent off-site areas that are critical to the long-term persistence of target species, may not benefit from conservation planning. Given the extent of private-sector conservation planning, this problem is unlikely to be resolved with any strategy short of a full regional habitat conservation plan — something that often is suggested, but rarely accomplished.

A common theme for conservation planning for butterflies is that planning increasingly focuses on proper ecosystem management — as reserve design options in urban and suburban areas dwindle, the development of resource management plans are taking center stage. Across California early conservation efforts designed to protect the state's threatened butterflies focused on reserve design, but the last decade has seen a shift toward ecosystem management — gorse removal on San Bruno Mountain for Mission blue butterflies, iceplant control for Smith's blue butterflies, buckwheat outplanting for El Segundo blues and Lange's metalmarks, and phased grazing for Bay checkerspot butterflies. Without the the implementation of management activities — phased grazing in grassland and scrub areas, and iceplant control in back-dune areas — lands set aside for Myrtle's silverspot butterfly will likely degrade and the butterfly well might continue to decline.

Acknowledgements. We wish to thank the following for support during this project: Gary Fellers, Point Reyes National Seashore; Sterling Mattoon; Chris Nagano, US Fish and Wildlife Service; Andrew Weiss, Center for Conservation Biology GIS manager; Center for Conservation Biology Field Crews (Steve Rottenborn, Erica Fleishman, Tom Sisk, Russ Bell, Jon Hoekstra, Ian Woods, Rob Blair, Jeff Hodgson, Matt Ballard, Kathy Switky, Stu Weiss, Ted Lee, Duncan Elkins, Stacey Motland, Flint Hughes, Katy Human, Angela Kalmer,

Rocky Beek, and Adam Welcher); and ESRI (for ARC/INFO and Digital Chart of the World). The 1993 mark-recapture study was conducted under Federal Fish and Wildlife permit number PRT-775311, and National Park Service "Collecting Permit" number 9211. We also wish to thank two anonymous reviewers whose comments enhanced this text.

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